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ACTION OF CHARRED PAPER ON THE PHOTOGRAPHIC PLATE AND A METHOD OF DECIPHERING CHARRED RECORDS

BY

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ACTION OF CHARRED PAPER ON THE PHOTOGRAPHIC PLATE AND A METHOD OF DECIPHERING CHARRED RECORDS.

By Raymond Davis.

ABSTRACT.

An investigation for a method of deciphering the written and printed matter contained on papers which have been charred, shows that good results may be had by the use of photographic plates.

The charred papers are placed in contact with the emulsion of fast or medium speed photographic plates and kept in this condition in total darkness for a period of from one to two weeks. They are then developed in the usual manner.

It appears that the gases contained in the charred papers have the power to fog the photographic plate and that the charred ink acts as a protective film, hindering the escape of the gas. That is, on development, it is found that the photographic plate has been blackened where it had been in contact with the charred paper, except in those places occupied by the ink.

Films are not as well adapted for this purpose as plates. For these much longer time is required, about two months, and, furthermore, the effect is positive instead of negative. That is, with films the ink is the active portion and the charred paper is inactive.

By washing a film in pure water for a short time and drying (in darkness) before placing in contact with the charred paper, results like those given by photographic plates are obtained.

Very slow plates, such as "process," and the enlarging and printing papers are not suited for the purpose because of their comparative insensitiveness to the gases.

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I. INTRODUCTION.

On various occasions this bureau has been called upon to decipher illegible documents and papers. These have been usually cases in which the writing had been partially or completely destroyed so far as detectible by the unaided eye, cases where forgery was suspected, or secret writings with invisible inks.

The problem of deciphering damaged or questioned documents is about as old as the art of writing. In cases of suspected forgery or altered writings, the possible methods of attack have been well investigated and to some extent standardized. By means of the camera, microscope, and chemical reagents it is often possible to detect alterations and additions to both handwriting and typewriting.[1] Damaged records and secret writings can often be deciphered by perseverance if the appropriate equipment is available. It may happen, however, that the destruction is so nearly complete or the "evidence" so fragmentary that success is not to be had.

Recently, the Bureau of Standards was requested by W. T. Ellington, superintendent of the mails, United States post office at Augusta, Ga., to attempt to decipher papers which had been charred in a fire which caused considerable loss of property in that city. Figure 1 is a photograph of one of the sheets submitted. The charred samples (three in number, approximately 8 by 10½ inches) had obviously been subjected to heat in a closed vessel, such as a safe; the paper having been converted into black sheets of carbon and not to ashes, as would have happened had they burned in an open container.

With casual observation no traces of writing are visible, but under certain critical conditions of lighting very faint traces of markings can be seen. These traces are not, however, sufficiently clear to permit deciphering.

II. PROCEDURE.

1. CHEMICAL.

In some preliminary trials made on paper charred for the purpose, conversion of the iron salts contained in the ink into colored salts was tried. These were unsuccessful. In others, where the ink was evidently quite heavy, copies were obtained by using hydrochloric acid and potassium ferricyanide, as follows: A blotter moistened with a solution of potassium ferricyanide was placed on the back of the charred paper and a piece of plain white paper in contact with the face or written side. With a blotter wet with dilute hydrochloric acid against a white paper the whole was placed in a letter press for several minutes. When successful, a reversed print of the writing appeared on the plain paper in a blurred blue color. However, the results led to the conclusion that such a method would be unsatisfactory.

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[1] See "Questioned Documents," by Osborn, Lawyers Cooperative Publishing Co., Rochester, N. Y., 1910.

2. PHOTOGRAPHIC.

It has been shown by Russell [2] and others that the photographic plate is sensitive to the action of certain gases and vapors and the action takes place without exposure to light.

Certain woods, resins, freshly scratched metals, etc., if left in contact with the photographic plate for a sufficient length of time yield on development in the usual manner characteristic markings—an image. The necessary time of contact between the substance and the plate varies from an hour to months, depending on the activity of the material, the temperature, and the kind or brand of photographic plate. The effects are ascribed to active gases or vapors freed from the material. On the other hand, the converse of these effects may be produced. Other gases and vapors which tend to prevent the liberation of the bromine of the sensitive salts of silver lower the sensitiveness of the plate and when sufficiently strong may completely desensitize it.

For the first trial a sheet of the carbonized paper was placed between two "fast" photographic plates and kept in the dark for two weeks. On development a very perfect copy of both the writing and the printing was obtained. Figure 2 is a print from such a negative. It appears that the carbonized paper contains gases that fog the photographic plate. Where the ink is present little or no effect takes place. Apparently the charred ink acts as a protective screen, hindering escape of the gas.

It is interesting to note that the writing on both sides of the charred paper appears in the print, that from the back being fainter than that from the face. Apparently the ink penetrates the paper so that its residue reduces the amount of gas escaping from beneath.

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[2] Proc. Royal Inst., May 5, 1899; also Jour. Royal Photographic Soc., November, 1908.

III. CHOICE OF PHOTOGRAPHIC MATERIALS.

1. PLATES.

Photographic plates of sensitiveness usually termed "medium" or "fast" are suitable for the purpose. However, the sensitiveness to light is no definite indication of the sensitiveness to charred paper. For example, Seed 30 and Seed 26X, the former being nearly twice as fast to light as the latter, have equal sensitiveness to the charred paper as shown in Figure 3. In this graph the measured "densities" of the silver deposit are plotted as ordinates against the exposure times in days as abscissas. This density, which measures the blackening of the plate, is defined as the logarithm of the opacity. Opacity is defined as the reciprocal of the transmission. The shape of the curve closely resembles the usual characteristic curve. Very slow plates such as "process" are not suitable, as exposure of 32 days shows only faint action.

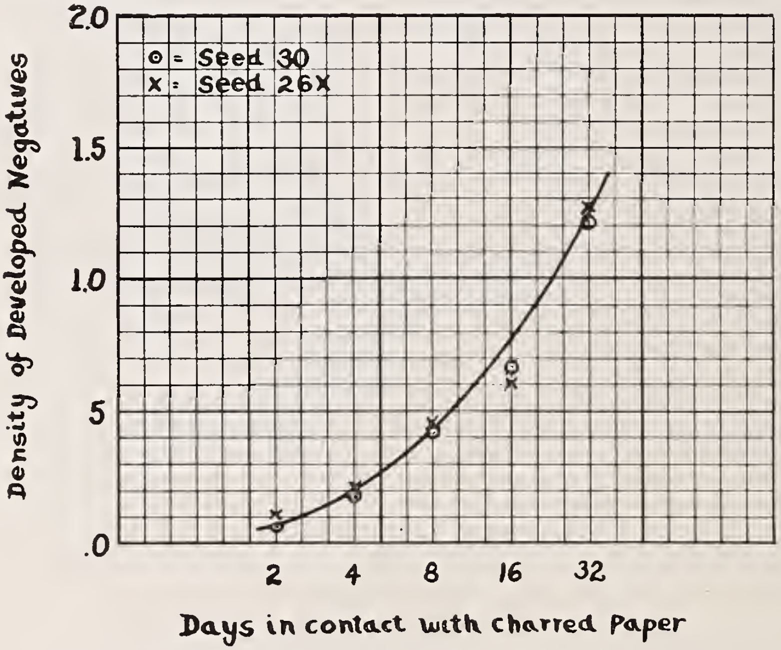

FIG. 3.—*The rate curve of the fogging action of the charred paper on Seed 30 and Seed 26X plates*

A sheet of charred paper was placed between the two kinds of plates at specified intervals. They were then developed together for the same length of time.

No attempt was made to determine the nature of the active material contained in the charred paper. It is quite likely that it contains products similar to those obtained by the destructive distillation of wood.

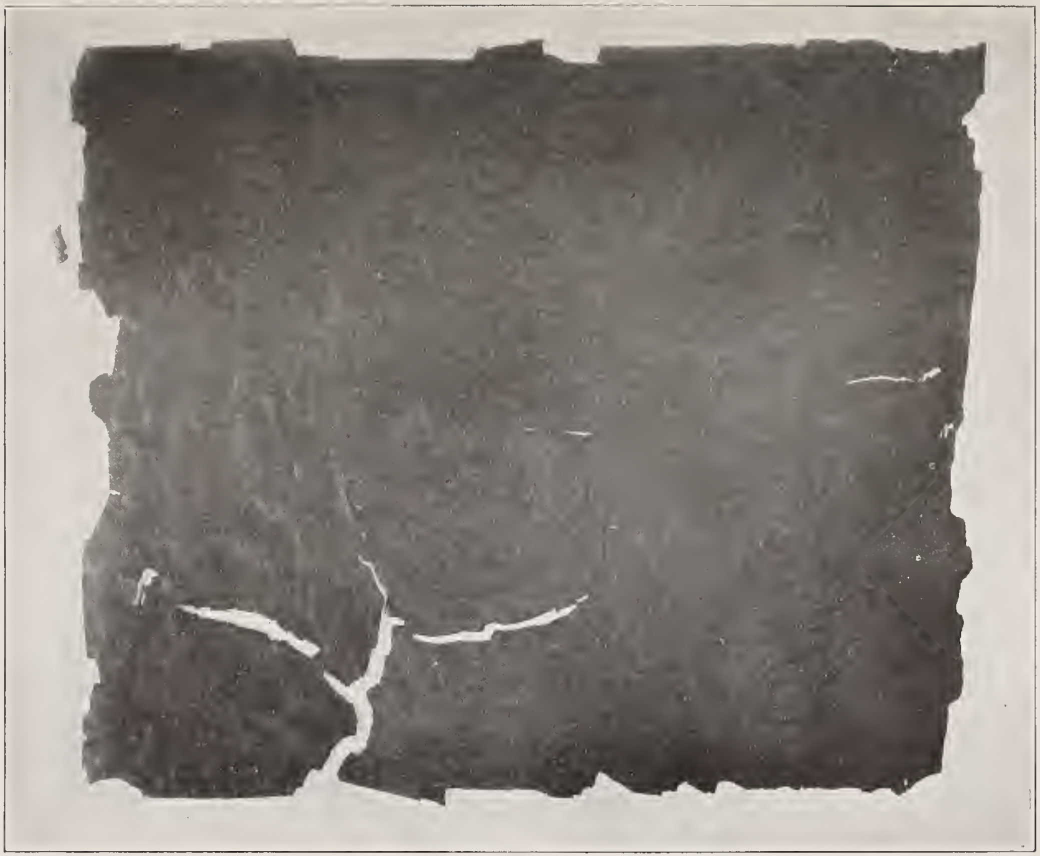

FIG. 1.—*Showing appearance of charred paper.*

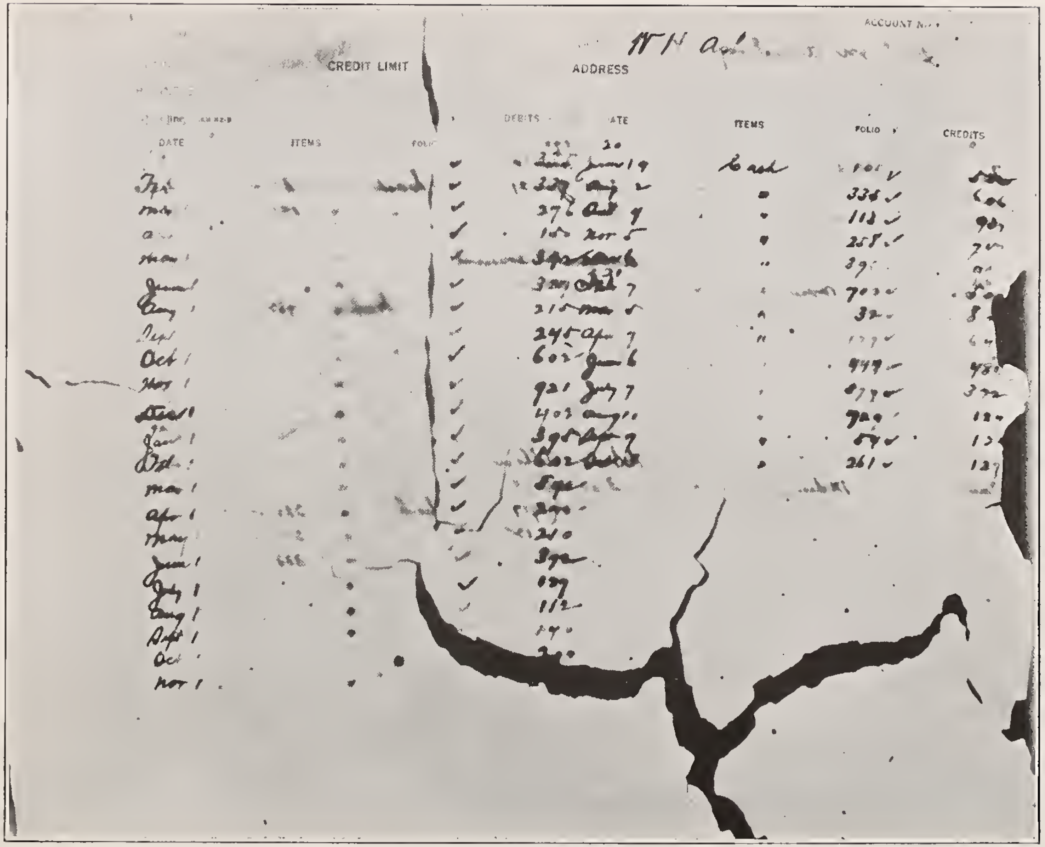

FIG. 2.—*Print made from negative showing writing and printing on the charred paper.*

The faint and blurred markings are caused by the ink on the opposite side. It will be seen from the tear that this is a print from the reverse side of the sheet shown in Figure 1.

2. FILMS.

Results obtained by the use of photographic films were very surprising, as shown by the two types of emulsions selected for the test, namely: Eastman "portrait film" and "Eastman super-speed portrait film."

The portrait film showed no effect in 32 days. The super speed portrait showed a very slight but interesting effect with a 16-day exposure and only a little better after 32 days. The reaction was just the reverse of that with the plates, the inked areas showing black on the films but clear on the plates. That is, with the films the ink is the active portion, the charred paper produces no fogging. It was also noted that the chemical fog of development is much lighter over the portions of the film covered by the charred paper as compared with the uncovered areas.

The results suggest that there are perhaps two kinds of gas given off, one kind by the charred paper and another by the ink, both of which fog the photographic emulsion. The one from the charred paper, however, affects the plate more intensely than the film while that from the ink is more active toward untreated films.

It was found that washing these films in distilled water for about five minutes,[3] followed by the thorough drying, gave results similar to those obtained with plates.

3. PAPERS.

Photographic papers are not suited for this purpose. The following papers showed no effect after contact with the charred papers for two weeks: Azo, Artura, Velox, Photostat, and Enameled Bromide. A sheet of Solio paper showed no effect after a 60-day exposure.

IV. THE EFFECT OF TIME ON ACTIVITY OF THE CHARRED PAPER.

As previously stated, three sheets of the charred paper were received and with these samples two weeks' contact was required with Seed 30 plates to produce a good printing negative. Later an entire ledger of the charred paper was submitted. With sheets of this only one week's contact with the same brand of plate was required to produce the same result as was obtained with the original samples in two weeks. It is natural to assume, therefore, that the active substance is gradually lost by exposure to air, the activity having dropped to one-half in about two months' time. After this, however, the rate of depletion has dropped considerably, no appreciable futher reduction in activity having been observed.

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[3] See Walters and Davis article, B. S. Scientific Paper No. 422, for beneficial effects on the color sensitivity, obtained by washing panchromatic plates previous to using.

V. SUMMARY.

An investigation for a method of deciphering the written and printed matter contained on papers which have been charred shows that good results may be had by the use of photographic plates.

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WASHINGTON, June 16, 1922.

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